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SCIENTIFIC RESEARCH, THE HOPE OF THE SOUTH[1]

By Dr. GEORGE D. PALMER

UNIVERSITY OF ALABAMA

I WISH, first, to discuss the importance of scientific research to the nation as a whole; second, to contrast the scientific research done in the North and the Far West with that done in the South; and third, to suggest ways of building up scientific research organizations in the South or in any other region.

We all know about the "Report on Economic Conditions of the South" prepared by the National Emergency Council for President Roosevelt, and his statement that "The South presents right now the Nation's number one economic problem." This report emphasizes our poor ranking in education, housing facilities, etc., but barely mentions our low ranking in the field of scientific research. This is all the more remarkable since we now know that the present status of the United States as the leading nation is due primarily to the *unbeatable combination of business and scientific research,* backed by our great resources.

Big business to-day is exploiting the fruits of our scientific research laboratories—our last remaining frontiers, our so-called "inner frontiers"—as during the past century it exploited our exterior—or geographical—frontiers. There is one big difference now—we shall never run out of "inner frontiers." Success in one field of scientific research immediately presents many new and worth-while fields.

It is this scientific research, chiefly in the fields of applied chemistry and physics, backed by excellent industrial organizations, which has enabled us gradually to forge ahead of all other countries. Our nation

[1] Address of the retiring president of the Alabama Academy of Science, Birmingham, Alabama, March 29, 1940.

has at last become intensely interested in scientific research, chiefly because there is "money in it" and also security against war. Dr. C. M. A. Stine, of the du Pont Company, vice-president in charge of research, has said that scientific research is a "definite contribution toward the maintenance of peace." It is the most useful tool of the democracies. If, as Walter Lippmann writes, "The democracies have become softened by a false sense of security," all the more do we need scientific research organizations to keep ahead of the dictatorships.

Our nation has now become the center of scientific research primarily through the large amount of work done during the past ten years by our industrial, educational and governmental scientific research organizations. Approximately $500,000,000 is invested each year in scientific research in the United States. Half of this, or $250,000,000, is invested by industrial concerns practically all in the North and Far West; the other half is invested by governmental and educational institutions, primarily in the North and Far West.

Three examples will indicate the extent to which industry invests in scientific research. Note that I use the word "invest" and not "spend." The research budget of the du Pont Company for the year 1939, was $7,000,000; that of the Dow Chemical Company, $1,400,000. The California Fruit Growers Exchange reports that their research for the past twenty-five years has "so far paid more than $8,000,000 in direct profits to growers and has led to two by-product plants." Twenty years ago there were about 100 companies investing money in scientific research. To-day, there are over 2,000 companies, practically all in the North and Far West, investing large sums of money in scientific research. Now double the amount of work done by these 2,000 companies, and you will have the total of all research done, including that done by about 200 universities, colleges and various research institutions, again, located primarily in the North and Far West—the richest sections of our country—thus making these rich sections richer.

There is never any doubt about the profits of organized scientific research, and these profits are progressively increasing in these modern times. In fact, the depression years have been the most outstanding years for industrial scientific research. This industrial scientific research is leading us into prosperity and will continue to lead us through prosperous times. We are in a "new era," a more realistic world, whether we like it or not, based more and more upon scientific research. This condition exists primarily because we now have in the United States more cooperation between the men of business and the men of science. James Truslow Adams, the historian, states in "Democracy at Work" that, as a nation, "We depend more and more on brains and less on brawn. We create our new horizons in the laboratory."

Because of the commercial importance of scientific research, many new concerns are establishing, and many older concerns are expanding their research laboratories. For example, the American Cyanamid and Chemical Corporation has just completed its magnificent new scientific research laboratory in Stamford, Connecticut. The American Telephone and Telegraph Company recently announced that it will build a new $3,000,000 research laboratory at Murray Hill to be completed in 1941. Many more laboratories have been completed and others announced for completion in the near future.

The importance of scientific research is well illustrated by recent developments in the airplane industry. According to a recent announcement, most of the research has been completed for building bombers capable of flying across the ocean and back on one fueling. More research will be done, and we will make this transatlantic round trip bomber, and so it goes. This probably means that transatlantic round trip bombers will eventually end the United States' isolation policy.

To realize the importance of scientific research, one only has to think of some of the things that we did not have ten years ago, such as transoceanic passenger air service, streamlined trains, new nylon synthetic silk for hosiery, glass-building blocks, glass textiles and insulation materials, new synthetic rubbers, television, new and very strong plywoods, synthetic vitamins and hormones, sulfanilamide and sulfapyridine drugs, etc. This in itself shows that business has invested heavily in its research laboratories during the past ten years of depression. Certainly, a great future awaits us in the United States. This is impressed upon one when he remembers that the bulk of scientific industrial research in the United States only began with World War number one.

We are remaking the world through our "inner frontiers"—our organized research laboratories. The whole of our future mechanical civilization depends upon them. At the present moment, a large number of new products of the research laboratories are almost ready to be put on the market. Some are being tried now on a small scale in certain sections of the country. All these and many more will be commonplace in a few years. Thus we may easily visualize the tremendous effect of scientific research upon our nation as a whole.

Now, I should like to emphasize the effect of scientific research on a given geographical section of the country. It is now well known that our "inner frontiers" are in the scientific research laboratories. We can no longer go West! We are now developing a new civilization based upon the products of the scientific research laboratories. As a result of this tremendous amount

of research activity in the United States (about $500,000,000 expended annually) the following rule stands out in bold relief: *The prosperity of a region is roughly proportional to the number of patents taken out in that region.* Consequently, you can readily understand that it is highly important that the South take steps so that Southerners intensely interested in the South will take out patents and develop fields which will utilize the resources of the South rather than those of some other section. This will create new industries and additional jobs in the South.

I realize the tremendous importance of the social, economic and educational forces that have such powerful influences upon our lives, yet as I see it, at the present stage, *the South's number one problem is the utilization of its natural resources through scientific research.* Our scientific research is lagging when compared with our social, economic and educational progress. The question immediately arises, what steps should be taken to enable the South to utilize its own natural resources? The general answer is—simply build up scientific research organizations similar to those in the North and Far West. Everything in science, as in other fields, is becoming highly organized. A lone scientist or inventor is able to do little. At the present time, we, in the South, need organization and help, but we should help ourselves. *We should develop our own scientific research organizations for work on Southern resources.* This may be done in many ways.

In the past, it has taken a man with determination, fighting ability, salesmanship and imagination to build up single-handed an industrial research laboratory in the South. We have had few such men. The only ones, so far as I know, are Theodore Swann, who lives in Birmingham, the late Charles H. Herty, who pioneered our new newsprint paper mill and laboratory at Savannah, and William H. Mason, of Laurel, Mississippi, who started the Masonite Corporation. If it had not been for Theodore Swann, the Monsanto Chemical Company would not now be in Anniston, nor the Swann Chemical Company in Birmingham, nor several other plants in other places. Swann has been the pioneer and one of the greatest exponents of Southern industrial research. The South needs more Theodore Swanns! In this connection, mention should certainly be made of the large part that patents played in the success of Erskine Ramsey, who likewise lives in Birmingham. Despite our lack of large industrial scientific research organizations, some outstanding scientific research has been done in the South. I should like to mention especially the making of cast-iron pipe by centrifugal force as developed in the Birmingham district.

The other day in his column in the Birmingham *Age-Herald,* John Temple Graves II described the following statement: "A revival of the pioneer spirit, a venturesome and creative outlook on the problems of our day," as the "eternal song" of Vanderbilt's Chancellor O. C. Carmichael. This is his "remedy for the sickness that has come over democracies." We need a revival of the pioneer spirit in scientific research in the South to-day.

Of course we are gradually developing some small research laboratories in the South, but this increase has taken place primarily during the past ten years, and is not at all in proportion to the amount of industry in the South. In fact, the scientific research laboratories pioneered by Swann and Mason are still the largest industrial research organizations existing in the South. Some of our paper mills are true Southern concerns and as such are helping to build up Southern scientific research. Apparently where the new research idea is born is where the research organization is built up, which in turn produces other new products and establishes more new industries with their resultant new research laboratories—the usual snowball effect. Ideas count tremendously in industry and most of them are born in the scientific research laboratories.

Heretofore, research activity has been in the interest of the North and Far West with the profits from new industries, monopolies of patents, etc., likewise going there. Although this scientific research has already greatly affected the South (and other regions) it will affect the South to a much greater extent in the very near future, and much more adversely unless we have our own scientific research organizations working in the interest of the South. The concentration of research in the North and Far West amounts to a scientific research differential, which is much more important than our freight differential, important as that is, because the research differential is more fundamental. We often hear of the absentee ownership of industries of the South, but we never hear about the absentee research done for these same industries.

A further step in the development of our Southern resources is being made at the present time, but it is the Federal Government who is doing it for us. I refer to the new $1,000,000 regional research laboratory recently established at New Orleans to obtain new products and uses of cotton, peanuts and sweet potatoes. This will help just as a government sweet potato research laboratory at Laurel, Mississippi, has already helped. More scientific research supported by the Federal Government is badly needed in the South. Although we recently obtained one of the four Federal regional laboratories—which in itself is geographically fair—in general, I can say that here again we have a governmental research differential. The rule of rewarding the institutions that have already established large research organizations is applied even by the Federal Government. Since the Federal Government

invested $60,000,000 last year in research, this is a considerable advantage. It is only fair to say, however, that such a project as TVA with its many research activities tends to eliminate this governmental research differential, for those living in that region.

This generally accepted custom of rewarding those institutions that have already established large research organizations destroys enthusiasm for research in the South. This in turn, has its effect upon industrial scientific research, and thus is another and very considerable factor in making the South poorer.

While there has been some decentralization of plants, there has been much more centralization of research and management. Research and management which usually go together, determine where the excess money of a region ultimately goes. This centralization of research and management in the North and Far West has drawn most of our competent Southern scientists away from the South. Many Southern scientists in charge of very important research work in the North and Far West would like to work in the South but are offered little inducement. Many scientists in Southern colleges and universities desire to work on Southern resources but have few facilities.

If you list the most important raw materials, such as coal, iron, petroleum, cellulose, salt, sulfur, phosphates, etc., and include power, you will find that the South has a near monopoly, or, as a minimum, has its share, in proportion to the rest of the United States. Since scientific research is necessary in the development of these vast resources, the South has done little toward the utilization of these raw materials. What has been done has been brought about almost entirely by outside capital.

According to Georgia's geologist Garland Peyton: "The Southeast is the only sector of the United States whose agricultural diversities, climate and mineral resources are sufficient to make it wholly self-supporting from the raw material standpoint." The Southeast is destined to become the greatest chemical manufacturing region in the nation because of these natural resources. The flow of chemical industries, paper mills, etc., to the South during the past ten years is excellent evidence that we are on our way. Dr. E. Emmet Reid, chemical consultant to many industries and Southern colleges and universities, informs me that for the past three years there has been more actual construction of chemical plants, or total expenditure for chemical plants, in the Southeast than in all the rest of the United States combined. However, research and management have seldom followed the flow of chemical plants into the South. The time required for the South to take the number one position in the chemical manufacturing field may be definitely speeded up by organizing our own research laboratories—not waiting for the other fellow. Then, too, by planning our own research, we can gradually build up our own industrialization. If we do not organize our own companies, and plan our own research, we still shall have absentee ownership and absentee research, and the South will continue to send most of its excess money up North.

I believe that, as Stewart J. Lloyd, dean of the school of chemistry, metallurgy and ceramics at the University of Alabama, has said, "A group of business men in the Birmingham district should get together and build up an industrial scientific research organization—not with the idea of subsidizing research, but to make money." This would help the Birmingham district and the South. The Mellon Institute at Pittsburgh has evolved many new industries for that and other regions. This type of organization is everyhere in the North and Far West. We need more Southern business men interested in science.

There is another type of scientific organization that the South needs. The February 1 issue of *Forbes* (business magazine) contained the announcement of the next logical step in New England's systematic method of increasing its scientific research. The larger companies of New England already have their research organizations. Now New England is starting to make scientific research organizations available to all their smaller industries.

Many leading industrial executives and scientists, under the leadership of Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, have organized New England's various research agencies into a unit, which gives technical assistance to small as well as large business establishments having research problems. This large-scale cooperative research project is the first of its kind in the United States.

Economic difficulties forced New England to originate cooperative science. This is the answer to those who may say that the South—or any other region—can not afford to do much research.

I do not wish you to think that I blame the Northern and Far Western interests for what they are doing. I am sure that we would do exactly the same thing under the same conditions. They are simply using good business methods. The South should form similar organizations. What New England is doing, other regions can do, thereby benefiting science and industry in the entire nation.

We need not fear that we shall over-expand in scientific research. Chaplin Tyler, of the du Pont Company, believes that at the present time it would be profitable for industry in the United States to do five times the amount of research it is now doing. Thus, should the South expand its research, it would be building up industry in the nation as a whole.

Southern industry and, in turn, Southern agriculture would be benefited enormously. Dr. C. M. A. Stine states the following:

> Chemical industry spends 2 per cent. to 4 per cent. (as high as 7 per cent. in some cases) of its gross sales revenue on research; agriculture, in contrast, spends only about one seventh of 1 per cent. of the value of its products on research. As much as $240,000,000 might be expended annually in the United States on agricultural research and the expenditure would not be at all fantastic nor out of line with need.

Money for scientific research is the greatest need of Southern colleges and universities at the present time. The legislatures of the Southern states should appropriate additional money to the universities and other state colleges for scientific research. This is undoubtedly the most important means of building up scientific research within the Southern states. In addition to state aid, many gifts for scientific research from business men and endowed foundations have helped Northern and Far Western educational institutions. Few such gifts have been made to Southern educational institutions. Of course, Federal aid for scientific research in Southern educational institutions would help solve the problem. We can not build up Southern industrial scientific research laboratories without the cooperation of Southern universities and colleges.

A large number of individual companies and many trade associations make research grants to educational institutions. Need I say that very few of these are given to Southern colleges and universities? We need to increase our industrial scientific research organizations, along with our university and college research organizations, so that our Southern-trained young men will remain in the South and build up the South. These will be the men who will have new ideas and create many new Southern industries. If we train Southern men in scientific research, a certain proportion of them will remain in the South. Hence, the universities and colleges should take the lead in building up scientific research in the South. We should strive to have at least one institution in each of the Southern states granting the Ph.D. and M.D. degrees.

We should also build up natural science education in the secondary schools. At present there is a strong trend away from natural science in these schools.

We should establish our own nationally great colleges and universities, our own grants-in-aid for research, our own journals for the publication of research, etc.

A direct way to encourage scientific research in the South would be for the Southern states to forego taxes on industrial, as well as on college and university research laboratories.

Now I should like to mention just a few ways in which I believe the Alabama Academy of Science can help in this program. The more interest in science on the part of the people of the state, the better off science will be in the state. We are certainly furthering this interest through our Junior and Senior Academies of Science. For the first time we have several important all-year-round committees to carry on the work of the Academy. We are progressing in our finances, our membership, and in our journal activities. We should further expand our journal so as to be able to publish valuable research pertaining to the state of Alabama that would not otherwise be published and thus kept for posterity. Many colleges, universities and other institutions, primarily in the North and Far West, are beginning to publish their own scientific manuscripts. This is a necessary trend in view of the large amount of scientific research now being done. We should work for the establishment of similar publications in the South. We should also increase our grants-in-aid for research. These are all valuable and sure ways of building up science in the state. We need state aid to adequately finance the academy. I believe our next step should be the formation of a Southeastern Scientific Society (S.S.S.), perhaps later to become the Southeastern Division of the A.A.A.S., similar to the Southwestern Division, and meeting with our various state academies. This should stimulate further interest in science in the Southeast.

Finally, I should like to say that I sincerely hope that by the end of the South's "ten year program of economic and cultural enrichment" sponsored by the Southern Governors' Conference and to be climaxed by a great world's fair of the South in 1950, we shall be able to report much progress in scientific research. Therein lies the hope of the South for the utilization of its own natural resources.

SCIENTIFIC EVENTS

FIELD PROGRAM OF THE CANADIAN BUREAU OF GEOLOGY AND TOPOGRAPHY

THIRTY-SEVEN geological and topographical survey and exploratory parties, comprising a force of about a hundred and seventy men, have been assigned to field work this year by the Mines and Geology Branch, Department of Mines and Resources, Ottawa. These parties, most of which will be leaving Ottawa in the immediate future, will map and investigate areas in every mineral-producing province in the Dominion and in Yukon and the Northwest Territories.

In view of the wartime requirements of the nation, particular attention is being given to investigations in connection with such minerals as have a direct bearing on the war effort. The work of the bureau is largely directed toward the extension of the gold-mining industry, which provides foreign credits, and toward an evaluation of resources in petroleum, an increased domestic supply of which is necessary to limit dependence on foreign sources. Investigations will be made also of deposits of many of the so-called war minerals, such as chromium, manganese, molybdenum and tungsten.

Twenty-six parties will be engaged in geological surveys and investigations, and eleven in topographical mapping. In addition, two topographical parties will be employed on supervisory work. Of the geological parties, three will be in British Columbia, five in Alberta, one in Saskatchewan, two in Manitoba, two in Ontario, four in Quebec, one in New Brunswick, one in New Brunswick and Nova Scotia, one in Nova Scotia, one in Yukon and three in the Northwest Territories. Two other parties will be employed on the general investigation of deposits of war minerals, one in British Columbia and Yukon and the other in the rest of Canada.

The topographical mapping program for 1940 will be devoted entirely to surveys in the foothills district of Alberta, which is now of such importance as a potential source of petroleum supplies. Ten topographical parties, one control party and two supervisory parties will operate in this district.

THE COOK OBSERVATORY

PLANS to proceed at once with continuation of the astronomical work begun by the late Gustavus Wynne Cook, the Philadelphia industrialist and amateur astronomer, who died on June 4, have been announced by the University of Pennsylvania. The work will be done with the astronomical equipment assembled and used by Dr. Cook in his private observatory at Wynnewood, Pa., which has been bequeathed to the university.

At the time of his death, Dr. Cook was engaged in making a photographic map of the Milky Way region. In preparation for this work he acquired in 1936 an astrographic telescope, said to be the largest in the world. A little more than half of the Milky Way section has already been photographed and its completion will be one of the immediate objectives of the observatory.

Dr. Charles P. Olivier, Flower professor of astronomy at the university and director of the Flower Observatory at Highland Park, who will direct the new program, has announced that Dr. P. H. Taylor, who has worked with him for the past four years, will work full time, and that in addition three part-time astronomers have been added to the staff. These include I. M. Levitt and L. I. Tabor, who were associated with Dr. Cook for several years, and Dr. Roy K. Marshall, a member of the staff of the Franklin Institute. Mr. Levitt, also a member of the staff of the institute and a former student of Dr. Olivier, will continue the work he has been doing with the spectrohelioscope at the Cook Observatory, cooperating in an international project for the study of solar eruptions. Mr. Tabor, who has been in charge of the work with the astrographic camera, will carry forward the work of mapping the Milky Way.

The work of the observatory will be continued for the present on the Cook estate in Wynnewood. This will permit certain lines of investigation to go forward without interruption. The program will be coordinated with that of the Flower Observatory and the equipment eventually will be placed with that of the Flower Observatory at some suitable location. The Cook unit will maintain its integrity and the name of Dr. Cook will be perpetuated. He is said to have spent approximately $200,000 on equipment for his observatory.

The bequest includes two buildings—a "sun house" and a "star house"—in addition to the equipment they contain. The largest telescope in the collection is a 28½-inch reflector, which will be used for the study of stellar spectra for the solution of special problems. There are also, in addition to the astrographic telescope and the spectrohelioscope, a 15-inch horizontal refracting telescope and a new Schmidt Camera of 14 inches aperture.

THE ILLINOIS–INDIANA SECTION OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

The Illinois-Indiana Section of the Society for the Promotion of Engineering Education held its annual meeting at the University of Notre Dame on April 21 with an attendance of nearly two hundred. After the Rev. J. Hugh O'Donnell, C.S.C., president of the university, welcomed the group, the Rev. John J. Cavanaugh, C.S.C., who is vice-president of the university, spoke on "Intellectual and Moral Education at Notre Dame," pointing out that Notre Dame is primarily concerned with the intellectual development of the student, but at the same time it integrates the religious and intellectual elements in higher education. Dean D. C. Jackson, Jr., of the College of Engineering, discussed "Engineering and Religion" and emphasized that "definite attention to integrating an intellectual study of religious principles and convictions into the engineering curricula is essential for the best progress of the progression of engineering in its broadening scope in approaching social problems in the future." Professor F. G. Seulberger, director of industrial relations at Northwestern University, gave an interest-

ing description of the plans for the new Northwestern Technological Institute. The section had two outside speakers: W. S. James, chief engineer of the Studebaker Corporation, and T. A. Boyd, director of development for General Motors Corporation. Mr. James pointed out that in industry the demand is for engineers well grounded in the fundamentals (physics, chemistry and mathematics) which should be taught throughout the entire undergraduate course in terms of their application to all types of engineering. Drawing upon his broad industrial experience for illustrations, Mr. Boyd emphasized the importance, regardless of the type of engineering studied, of pursuing the research method in all subjects.

The following officers of the section were elected for 1940–41: *Chairman,* W. A. Knapp, assistant dean of engineering, Purdue University; *Secretary,* George A. Maney, Northwestern University; *Members of the Executive Committee,* J. G. Potter, Armour Institute of Technology; L. F. Stauder, University of Notre Dame; P. G. Andres, Lewis Institute; H. A. Moench, Rose Polytechnic Institute, and F. L. Ehasz, University of Illinois.

OFFICERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

DR. R. W. SORENSEN, professor of electrical engineering and head of the department of electrical engineering at the California Institute of Technology, was elected president of the American Institute of Electrical Engineers for the year beginning August 1, as announced at the annual meeting held in Swampscott, Mass., during the summer convention of the institute. The other officers elected were: *Vice-presidents,* Everett S. Lee, Schenectady, N. Y.; J. W. Barker, New York; K. L. Hansen, Milwaukee; J. L. Hamilton, St. Louis; A. LeRoy Taylor, Salt Lake City; *Directors,* T. F. Barton, New York; M. S. Coover, Ames; R. G. Warner, New Haven; *National Treasurer,* W. I. Slichter, New York (reelected).

These officers together with the following hold-over officers will constitute the Board of Directors for the next administrative year beginning on August 1: F. Malcolm Farmer (retiring president), New York; C. R. Beardsley, New York; V. Bush, Washington, D. C.; M. Eldredge, Memphis; R. E. Hellmund, East Pittsburgh; H. W. Hitchcock, Los Angeles; F. H. Lane, Chicago; L. R. Mapes, Chicago; F. R. Maxwell, Jr., University, Ala.; F. J. Meyer, Oklahoma City; H. S. Osborne, New York; John C. Parker, New York; D. C. Prince, Schenectady; C. T. Sinclair, Pittsburgh; J. M. Thomson, Toronto; A. L. Turner, Omaha.

The annual report of the Board of Directors, presented at the meeting, showed a total membership on April 30 of 17,213. In addition to two national conventions and three district meetings, 2,047 meetings were held during the year by the local organizations of the institute in the principal cities and educational institutions in the United States, Canada and Mexico.

H. H. HENLINE,
National Secretary

RECENT DEATHS

DR. RALPH MODJESKI, civil engineer of New York City, known especially for his work as designer and consultant in bridge construction, died on June 26 at the age of seventy-nine years.

DR. FERMEN L. PICKETT, since 1930 dean of the Graduate School and for twenty-three years head of the department of botany at Washington State College, died on June 27 at the age of fifty-nine years.

JAMES HENRY FLEMING, of Toronto, past president of the American Ornithological Union and owner of a private museum of birds, died on June 27. He was sixty-seven years old. Mr. Fleming had been honorary curator of ornithology of the National Museum of Canada for twenty-seven years and since 1927 of the Royal Ontario Museum of Zoology.

DR. ALFRED FOWLER, the British astronomer, from 1923 to 1934 Yarrow research professor of the Royal Society, London, died on June 25 at the age of seventy-two years.

DR. AUGUSTUS EDWARD HOUGH LOVE, professor of natural philosophy at the University of Oxford, died on June 5 at the age of seventy-seven years.

ROBERT MACFARLANE CHAPIN, chief of the Biochemic Division of the Bureau of Animal Industry of the U. S. Department of Agriculture, died on May 6. He was sixty-two years of age. A correspondent writes: "A native of Massachusetts, Mr. Chapin was graduated from Amherst College in 1897. He took post-graduate work and served as instructor in chemistry until entering the service of the bureau in 1907. There he engaged in biochemical research relating largely to the development and standardization of disinfectants, livestock dips and related products. He was associated for many years with Dr. M. Dorset, discoverer of anti-hog-cholera serum, whom he succeeded as chief of the Biochemic Division in 1935. Since that time he has directed a wide range of research and service activities, including the preparation of tuberculin used in the nation-wide campaign to eradicate bovine tuberculosis, and also supervision of the stained antigen used extensively for the control of pullorum disease of poultry. Mr. Chapin was the author of numerous publications and collaborated with other investigators in many productive research studies."

SCIENTIFIC NOTES AND NEWS

THE Duddell Medal of the Physical Society, London, has been awarded to Professor Ernest O. Lawrence, of the University of California, for "his invention and subsequent development of the cyclotron."

THE Distinguished Service Medal was awarded at the New York meeting of the American Medical Association to Dr. Chevalier Jackson, until his resignation in 1930 professor of bronchoscopy and esophagoscopy at the Graduate School of Medicine of the University of Pennsylvania and at Jefferson Medical College, Philadelphia, and later, until his recent retirement, professor of clinical bronchoscopy at Temple University.

DR. A. C. FIELDNER, director of research at the U. S. Bureau of Mines, was presented with the Sullivant Medal of the Ohio State University at the commencement exercises on June 10. The medal is awarded every five years to "a graduate of the university for outstanding achievement."

DR. JOHN R. WILLIAMS has been awarded the Albert David Kaiser Medal of the Rochester Academy of Science "for service to the community and to the medical profession." The citation, according to the *Journal* of the American Medical Association, reads: "Dr. Williams has been the leading spirit, guide and director in the establishment of the Medical Museum in the Rochester Academy of Medicine, which from its beginning has maintained a high standard of educational value for the medical profession and the public."

IN recognition of his "outstanding service to psychiatry" Boston University conferred at commencement the honorary degree of doctor of science on Dr. Winfred Overholser, superintendent of St. Elizabeths Hospital, Washington.

DR. B. SMITH HOPKINS, professor of chemistry at the University of Illinois, was on June 10 awarded the honorary degree of doctor of laws by Carroll College, Waukesha, Wis.

THE Cross of the Commander of the Order of Alexander of Bulgaria has been conferred on Dr. Wolfgang Ostwald, professor of colloid chemistry at the University of Leipzig.

THE Robert Bunsen Memorial Medal has been awarded to Dr. Friedrich Rudolf Schenck, director of the State Institute for Metallurgical Chemistry at Marburg.

THE American Association for the Study of Allergy, meeting in New York City on June 10 and 11, elected the following officers: *President,* Dr. Robert L. Benson, Portland, Ore.; *President-elect,* Dr. Milton B. Cohen, Cleveland; *Vice-president,* Dr. Samuel M. Feinberg, Chicago.

AT the anniversary meeting of the Linnean Society of London held on May 24 the following officers were elected: *President,* Dr. E. S. Russell; *Treasurer,* Francis Druce; *Secretaries,* I. Henry Burkill for botany, and Dr. Malcolm Smith for zoology.

DR. EVERETT STANLEY WALLIS, associate professor of chemistry at Princeton University, has become A. Barton Hepburn professor of organic chemistry, succeeding Dr. Lauder W. Jones, who retired in 1937.

DR. FRANCIS CARTER WOOD has been made director emeritus of the Institute of Cancer Research at the College of Physicians and Surgeons of Columbia University. He will continue in private practice. It is also announced that the institute has been converted into the department of cancer research of the medical school, with Dr. William H. Woglom, associate professor of cancer research, as acting executive officer.

DR. ERNEST H. HUNTRESS, associate professor of organic chemistry in charge of the Undergraduate Division of the Massachusetts Institute of Technology, has become chairman of the Graduate School of Chemistry. He succeeds Dr. James F. Norris.

DR. J. P. GUILFORD, professor of psychology and director of the Bureau of Instructional Research at the University of Nebraska, has been appointed professor of psychology at the University of Southern California. Dr. H. M. Cox succeeds him as director of the Bureau of Instructional Research.

DR. JOHN L. RICH has been appointed head of the department of geology and geography of the University of Cincinnati; Daniel R. Bergsmark has been promoted from assistant professor to associate professor of geography, and Otto C. von Schlichten, to associate professor of geology. Dr. Kenneth E. Caster, curator of the museum, has been made assistant professor of geology.

DR. WYNFRID LAURENCE HENRY DUCKWORTH, reader in anatomy at the University of Cambridge, has been elected master of Jesus College.

THE du Pont Fellowship of the value of $2,000 for advanced study in chemistry at Harvard University, has been awarded to Douglas M. Bowen, of Glen Ridge, N. J.

THE B. G. Lamme Graduate Scholarship of the Westinghouse Electric Company for the year 1940–41 has been awarded to John W. McNall, research engineer of the company at Bloomfield, N. J. The Lamme scholarships are provided for by a fund, established about twelve years ago as a memorial to the late Ben-

jamin Garver Lamme, who was for many years chief engineer of the company.

DR. EVARTS A. GRAHAM, professor of surgery in the School of Medicine of Washington University, St. Louis, president of the American College of Surgeons, has been made chairman of the surgical advisory committee on national defense of the National Research Council in collaboration with Surgeon-General James Carre Magee, of the Army, and Surgeon-General Ross T. McIntire, of the Navy.

LOREN C. EISELEY, assistant professor of anthropology at the University of Kansas, has a year's leave of absence to enable him to accept a post-doctoral research training fellowship in physical anthropology from the Social Science Research Council.

W. B. VAN ARSDEL has been appointed chief of the Division of Engineering and Development of the Western Regional Research Laboratory of the U. S. Department of Agriculture at Albany, Calif. He will be in charge of the engineering development of processes worked out in the Western Laboratory and the study of industrial opportunities for expanding outlets for farm products. Dr. G. E. Hilbert has been appointed head of the Starch and Dextrose Division of the Northern Regional Research Laboratory at Peoria, Ill.

DR. W. W. ALEXANDER has resigned as administrator of the Farm Security Administration to become vice-president of the Julius Rosenwald Fund.

ARCHIE J. WEITH has been appointed director of research at the Bloomfield Research and Development Laboratories of the Bakelite Company.

DR. NATHAN WEINER, of Harvard University, late research assistant to Dr. Arthur Michel, and Dr. Joseph T. Bashour, late research assistant to Dr. Zannetti, of Columbia University, have joined the research staff of Endo Products, Inc., Richmond Hill, New York.

DR. H. SHAW, keeper of the Department of Physics and Geophysics at the Science Museum, South Kensington, has been appointed acting director of the museum during the absence of Brigadier E. E. B. Mackintosh.

DR. E. H. CLUVER, secretary for public health and chief health officer for the Union of South Africa, has been appointed director of the South African Institute for Medical Research in succession to the late Sir Spencer Lister. Dr. George Buchanan, superintendent, has been appointed deputy director.

THE British Association has decided to cancel the Conference on Science in its National and International Aspects which was to have been held at Reading from July 25 to 27.

Nature states that the fifth International Congress of the History of Sciences will be held at Lausanne next September if the political and social conditions of Europe permit. M. Aldo Mielli, the perpetual secretary of the International Academy of the History of Sciences, having now settled at Santa Fé in the Argentine Republic as director of the history of sciences at Santa Fé University, M. J. A. Vollgraf, of Leyden, has been appointed assistant secretary for Europe. The review *Archeion,* the official organ of the academy, will henceforth be published at Santa Fé instead of at Rome as hitherto.

THE Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture took over on June 27 its new headquarters at 209 River Street, Hoboken, N. J., where imported plants must be treated before being admitted into the country. The building is four stories in height and was erected at a cost of $400,000. It took two years to construct and replaces a group of buildings in Washington in which the bureau was housed. The bureau will be directed by Dr. George G. Becker, senior entomologist.

THE U. S. Civil Service urges explosive chemists to apply at once for the civil service examinations now open for the various grades of chemist and chemical technologist positions in the federal service. It is pointed out that in connection with the present defense program it is important that a large number of well-qualified explosive chemists and chemical technologists be immediately available should vacancies occur in this field. The salaries for the positions for which these examinations have been announced range from $2,600 to $4,600 a year. Applications must be on file with the U. S. Civil Service Commission at Washington, D. C., not later than July 15, or three days later from states west of Colorado. Information in regard to the examination can be obtained from the Secretary of the Board of U. S. Civil Service Examiners, at any first or second-class post office, or from the Washington office of the commission.

AT the annual meeting of the American Society of Tropical Medicine in Memphis, the Bailey K. Ashford Award in Tropical Medicine was established by Eli Lilly and Company to provide for three awards on alternate years. The award will be $1,000 and a bronze medal suitably engraved. An additional amount of $150 or as much thereof as may be necessary is available toward traveling expenses for the recipient of the award.

Museum News reports that by the will of William Benbridge Wetherill, former president of the Tippe-

canoe County Historical Association, Lafayette, Ind., the Board of County Commissioners receives in trust for the association the Wetherill home, with its contents and a trust fund of $100,000 for the erection of a museum, or museum rooms and auditorium on the property. If the entire amount of the fund is not required for the construction, the remainder may be used for improvements or as a maintenance fund. The will provides also for a $5,000 trust fund to be added to Dr. Wetherill's previous gifts to the association.

A COUNCIL of eleven members has been named to conduct the newly established University Research Institute of the University of Texas, which will cover the field of research in business, city government, engineering, economic geology, industrial chemistry and the social sciences. It has been granted an initial budget of $25,000 annually. Members of the council include Drs. J. T. Patterson, R. L. Moore, E. H. Sellards, R. J. Williams, E. C. Barker, F. C. Ayer, J. C. Dolley and Theodore Hornberger. Dr. A. P. Brogan, dean of the Graduate School, has been made chairman. W. R. Woolrich, dean of engineering, and Dr. W. E. Gettys, director of social science research, have been named ex-officio councilmen. Dean Brogan explained that the new program will provide for the first time university money to match grants from educational and scientific foundations which have fallen heretofore outside established university studies.

A REPORT of the British Home Office relating to experiments on living animals shows, according to a summary in the London *Times*, that the total number of experiments performed during 1938 was 958,761, or 39,801 more than in 1937. The number of experiments performed with anesthetics was 49,915, being 9,596 more than in 1937. The number of experiments comprising inoculations, hypodermic injections and other proceedings performed without anesthetics was 908,846, 30,205 more than in 1937. Of the 49,915 experiments performed with anesthetics, comprising all the cases in which a serious operation was involved, 14,797 were performed under license alone or under certificate C, and therefore came under the provision of the act that the animal must be kept under an anesthetic during the whole of the experiment. The experiments performed without anesthetics—908,846 in number—were mostly inoculations and feeding experiments. In addition, a certain number consisted of oral administrations, inhalations, external applications and the abstraction of body fluids. A large number of experiments, almost wholly simple inoculations and similar proceedings, were performed either on behalf of official bodies, with a view to the preservation of the public health or directly for the diagnosis and treatment of disease. Over 183,000 experiments were reported by 365 licensees as having been performed for Government Departments, the Medical Research Council, county councils, municipal corporations or other public health authorities.

DISCUSSION

A POSSIBLE EXPLANATION OF DEEP-FOCUS QUAKES

IN view of the interest shown at the Washington meeting of the International Union of Geodesy and Geophysics in the explanation of deep-focus quakes, it seems appropriate to air a suggested explanation of such quakes advanced informally at a meeting of the Geological Society of America by the writer—an explanation which time has so far prevented his testing properly.

Seismological evidence indicates that some quakes have their origin as far down in the earth as 500 miles or more. From the large amplitude of the shear waves in these quakes we must conclude that considerable shear energy is released. This implies that at a depth of 500 miles in the earth we have a region where resistance to distortion is possible and shear energy can be stored up—quite contrary to geologists' notions of conditions at such a depth. In view of this implication, Jeffreys and others are prepared to attribute finite strength in the earth to this required depth of 500 miles. At the international meeting mentioned, Jeffreys seemed even willing to throw overboard the theory of isostasy. Before thus rejecting orthodox geological views of the earth's interior, the present note suggests another possibility, namely, that in the so-called deep-focus quakes, the quake or fracture actually occurs comparatively near the surface but that a real image of it is formed some hundreds of miles down and it is from this focal point that the seismologist's waves start. The first question that arises on such a hypothesis is—does the seismologist then receive waves both from the quake and from its image or only from its image?

Clearly waves must be emitted from such a near surface fracture, but there are two reasons why perhaps they are not recorded. It is not at all uncommon for the first impulse of a compressional wave on a seismograph record to be preceded some ten or twelve seconds by an emergence. As its name implies, an emergence is a gradual beginning. If we can actually identify such emergences ten or twelve seconds before an impulse, it may well be that some emergences too faint to be identified arrive many seconds earlier still;

hence, the first possibility is that at the quake itself the energy is spread over such a wide area that the waves emitted, unless brought to a focus, possess too little energy to make a perceptible record.

The other possibility is that the seismologists receive waves only from the real image of the hypocenter and not even feeble ones from the hypocenter itself. In this case we should have to postulate that the waves from the hypocenter were screened from the observing stations. The nature of this screening brings us to the question of how such a real image could be formed.

If we adopt Airy's view of mountain roots, it is easy to picture the roots as forming a vast parabolic basin which would act as a mirror with the reflecting surface the denser material in which the mountains may be considered as floating. If we take the Himalayas or the Hindu Kush Mountains where the quakes which occur are consistently of the same depth of focus, about 200 kms, the mountain roots would have to form a parabolic mirror extending this depth into the isostatic level and in length and width extending roughly the length and width of the mountain range.

Such a parabolic mirror, formed by sufficiently deep roots of a mountain range such as the Himalayas, could conceivably account for a real image of a surface fracture such as we have pictured, but the mountain roots would have to be deeper than previously imagined. For land quakes such as those occurring in the Hindu Kush Mountains, the fracture might occur above sea level, and hence only those rays brought to a focus below would be recorded. Those traveling direct from the fracture would strike the side of the mountain and give rise to but very feeble surface waves. For sea quakes, *i.e.,* quakes with their origin in sub-oceanic areas, we should have to postulate a screening effect by internal reflection from the sides of the parabolic mirror.

In conclusion, it must be emphasized that there is no evidence so far adduced to show that such image foci actually exist, but on the other hand there seems to be no evidence to show that they can not exist. Their existence is suggested as a possible alternative to overthrowing the existing geological picture of an earth with a rigid outer structure extending only some sixty or seventy miles. One step toward testing the theory is being made. Records of deep-focus quakes are being carefully scanned for evidence of phases earlier than the regular P phases. Naturally, one would not expect perfect screening of waves from an extended fracture and if there are two such hypocenters, a real one and its image, one should expect at least occasionally to pick up waves from each.

JOSEPH LYNCH, S.J.

FORDHAM UNIVERSITY

RESISTANCE TO SULFANILYL DERIVATIVES IN VITRO AND IN VIVO

DURING the past year and a half, we have characterized the growth of bacteria in broth by two constants, the time T required to reach a slight but definite turbidity,[1] and the slope K of the logarithmic increase thereafter. Organisms grown in the presence of sulfanilamide, sulfapyridine, or sulfamethylthiazole can show a marked increase in T accompanied by a much smaller change in K, indicating the development of resistance after a period of inhibition.

This resistance is partly temporary, and partly "permanent" (*i.e.,* appears in subcultures). The "permanent" resistance may be intensified by continued subculture in the presence of the drug, as shown by others for Pneumococcus[2] and Gonococcus.[3] We have found that eventually both T and K of the resistant strain grown in the presence of the drug approximate those of the parent strain tested in the absence of the drug.

The development of such resistance appears to be a general phenomenon. It also occurs *in vivo* during a course of therapy, as reported for Pneumococcus against sulfapyridine,[4] and as we have found in Staphylococcus aureus against sulfamethylthiazole.

The question arises whether organisms made resistant to one drug also are resistant to related drugs. We have found that two types exist, A, those in which resistance induced by one drug (*e.g.,* sulfanilamide) is carried over, and B those in which it is not. The metabolically versatile E. coli and Staphylococcus aureus belong to type A, whereas the fastidious Hemophilus parainfluenzae belongs to type B.

The implications of the foregoing for the theory of drug action and the control of therapy are obvious.

JEROME S. HARRIS
HENRY I. KOHN

DUKE UNIVERSITY SCHOOL OF MEDICINE

COLLECTING SUBTROPICAL PLANTS AND ANIMALS IN NORTHERN OHIO

CONCERNING the spread of animals and plants throughout the United States, it is of interest to consider the probable roles played by the various aquatic plant nurseries, such as the William Tricker Company in Independence, Ohio, which import plants from many tropical and subtropical areas throughout the world, and, in turn, ship them to places all over the country.

During the entire year, the pools of this company serve as a reliable source of extremely interesting

[1] The optical density determined in the Evelyn photoelectric colorimeter is directly proportional to the number of organisms.

[2] C. M. MacLeod and G. Daddi, *Proc. Soc. Exper. Biol. and Med.*, 41: 69, 1939.

[3] L. Westphal, R. L. Charles and C. M. Carpenter, *Jour. Bact.*, 39: 47, 1940.

[4] R. W. Ross, *Lancet*, 1: 1207, 1939.

forms, which come and go. Those which are not quite so ephemeral remain and can be observed at any time.

For the last four years, collections of the red algae, *Compsopogon coeruleus,* have been made there. It is one of the rarer members of the family, and it is especially interesting to observe it spreading among local indoor pools and aquaria.

In January, 1934, approximately, *Lophopodella carterii,* the bryozoan, first appeared in the warm water of the greenhouse pools, and since has spread throughout northern Ohio. I have actually seen many plants covered with this beautiful form being sent to water-garden enthusiasts in various sections of the country. Interestingly enough, too, this same company has its main plant, seventeen acres of growing pools and greenhouses, located at Saddle River, New Jersey, the same state in which Dr. Dahlgren, of Princeton University, observed the animal.

CHARLES OTTO MASTERS
WESTERN RESERVE UNIVERSITY

COLLECTION OF UNORTHODOX CURIOSA

THE writer has in his possession about two cubic feet of pamphlets and books, nearly all "published by the author," which fall in the category perhaps most charitably designated as unorthodox hypotheses in science (they bear earmarks which scientific men will recognize from this description), and which he has thought of donating to some institutional library where there might be a special interest in the history of science. The collection, for its possible value as curiosa, may not be considered worth shelf room, but, on the other hand, it might prove to be of interest or value to future historians of science and civilization, showing as it would that ours was not yet altogether an age of science, and that there existed among the public considerable opposition to what is often sarcastically described as "orthodox science."

ALBERT G. INGALLS
SCIENTIFIC AMERICAN

SCIENTIFIC BOOKS

THE PAGEANT OF ELECTRICITY

The Pageant of Electricity. By ALFRED P. MORGAN. xxvi + 363 pp. D. Appleton-Century Company. 1939.

THIS book is one in the series of "Science for the Layman." The author has written numerous books on popular science and has been an editor of a boys' magazine. However, this book is for mature readers.

The pageant of electricity is a brilliant and fascinating exhibition from whatever angle it is viewed. Here is pictured chiefly the application of electrical principles in commerce, industry, human affairs. The body of the text is preceded by eight pages of chronology of important dates (about 120) in the history of electricity from Roger Bacon to the present time. Three chapters, seventy pages, suffice to bring the story up to Faraday. In these chapters brief, very qualitative statements are made concerning electrical principles. Then the author turns to applications, the development of the telegraph, the career of Edison, the history of the telephone, "electrons dispel darkness" or the story of electrical illumination, electricity carries burdens, electricity and chemistry (the story of aluminum), electron bullets or x-rays, Hertzian waves and radio (100 pages), Doctor Electron or electricity in the hospital.

The story is well told. There is a wealth of historical material, quite a little of which is not found in histories of physics. The author is obviously well acquainted with the commercial side of electricity, and with museums in which are kept models of early forms of telegraph and telephone instruments, early incandescent lamps, electric generators, electron tubes, etc. Many interesting cuts illustrate these devices. Any one desirous of reading the story of the evolution of electrical applications will find these pages appealing and instructive.

The book can not be regarded as a history of electricity from the point of view of a physicist. For example, in the first few pages the author discusses the electron theory of matter. Here he is at least eight years behind the times. For, according to him, the nucleus still consists of electrons and protons instead of neutrons and protons. The term neutron appears once, but there is no place for it in an atom. A conventional model of a hydrogen atom is shown as consisting of two positive and two negative charges. There are other minor criticisms which may be made by a physicist.

But when the author turns to the development of commercial electrical devices, he is at home. Especially is this true in dealing with the contribution of Edison, of Bell, Marconi, DeForest and Major Armstrong. The patent litigation between the last two *inventors* requires several pages for its telling. Here the author very vigorously takes sides. He intimates that the Supreme Court was incapable of understanding the point upon which judgment was to be rendered. "Decision was rendered in favor of De Forest on a matter of *law,* the court not undertaking to *pass on the facts*" (italics are the author's). "But Armstrong had

not lost any prestige in the scientific world. He remained the inventor of regeneration there." All through the discussion of the development of the electron tube and the associated circuits, the author makes it clear that he regards Major Armstrong as a brilliant experimentalist. For example (p. 303), "At twenty-three years of age Armstrong understood the audion better than anyone else in the world." The author does not seem to attach any importance to the pioneer work of O. W. Richardson in giving us the law of electron emission, of Professor Child in setting forth the space-charge relation, of van der Bijl, who gave the quantitative relation for amplification, of Wehnelt, Schottky and others, who had shown the importance of the emitting surface. None of these names occurs in the book.

The reviewer wonders if any one *invented* the regeneration circuit, or rather, if every one working with an electron tube, after van der Bijl and including him, did not invent it. Given the idea of amplification, the circuit is obvious. Many experimenters must have used the circuit, but they weren't in the patenting business. One wonders upon what towering pinnacle Major Armstrong would have been placed had the author been acquainted with or given attention to the recent loudly advertised frequency modulation.

In this chapter there is a minor criticism. The author accounts for the ending *tron* of many of our words, magnetron, radiotron, kenotron, etc., by saying that the Greek word *tron* means empty. There is no such word in the reviewer's lexicons. It is highly probable that the ending is due to that of *electron,* the Greek word for amber. It has a pleasant sound, so why not magnetron, etc.?

The last chapter deals with the attempts to cure human ills from the days when all was mystery and magic to the present time when there is a very small element of knowledge. There is held up for ridicule the use by the Rosicrucians of the occult powers of the magnet—or of something which they called a magnet—but praise is given to the use of fever produced by high-frequency radio waves in the cure of insanity and syphilis (!). It is stated that small-pox can be cured by red light and skin tuberculosis by blue. But the reviewer is of the impression that red light is used in small-pox cases as it is in developing a photographic plate. It would be better not to use any visible light. (Radiant energy is always present.)

In our enthusiasm for modern devices it might be well not to overstate our case.

Radio surgery or the use of the radio knife is praised. The radio knife, more accurately the radio needle or acusector, uses high-frequency oscillations for cutting out, by burning or searing, unwanted tissue. It is stated that Dr. George A. Wyeth, by inventing the endotherm, put electro surgery on the map. Now this instrument with the aristocratic name enables one to use *damped* electrical oscillations obtained by the old spark method or, by throwing a switch, *undamped* oscillations produced by an electron tube. It is claimed that damped oscillations must be used for one purpose, undamped for another. But why undamped can not do everything that can be done by electrical waves the surgeons can not tell us—nor can anyone else. It shows that the medical profession has not emerged from the days of a generation ago, when patients were made to believe that galvanic currents had to be used for one purpose, faradic for another. The patient was awed by the doctor's great knowledge. The magic of to-day, if not black, is at times rather dark and sometimes shady. That remark, however, does not apply to the endotherm which has been an important instrument in radio surgery.

GORDON FERRIE HULL

DARTMOUTH COLLEGE

AGING

Das Problem des Alterns und die Chemie der Lebensvorgange. 2. Auflage. By D. REICHINSTEIN. 420 pp., 16 figs. Zurich: H. Akerets Erben Publishing House. 1940. $9.00.

THE first section of this work presents the conventional summary found in the usual non-critical review of aging. For the most part, the material is old and evidently taken from the familiar German reviews which have appeared in the past. It will prove of little interest to those familiar with the field and of little help to others since it has so few references that the location of the source material will be very difficult.

In the section devoted to the aging of cells, much attention is given to the pigments and the well-known theories of Mühlmann.

After such an introduction physical chemistry is dragged into the field of aging. Great labor is expended in attempting to make physical chemistry encompass the field of aging, but this elusive field constantly seems to escape. The final conclusion of the reader is that much too little is known experimentally about the processes of aging to apply physical chemical theory. The author's attempts are interesting but rather speculative.

Under the section devoted to the chemistry of life processes are discussed such diverse subjects as "Prontosil," choline, certain phases of endocrinology, with some consideration of cellular oxidation and enzyme action. As a whole, the thread of the story is difficult to follow and gives the impression of notes taken by the author on current science which has interested him.

The final section upon the theories of aging affords little that is new and much that could be forgotten.

In general this work neglects modern literature. It lacks the critical approach of such reviews as that of

Professor Carlson in Cowdry's "Problems of Aging." The field covered is very restricted in comparison with the work of Cowdry. The most useful contribution of Reichinstein's work is the presentation of his ideas concerning the possible explanation of aging processes on the basis of classical physical chemistry.

C. M. McCAY

CORNELL UNIVERSITY

SOCIETIES AND MEETINGS

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE twenty-second annual meeting of the New Hampshire Academy of Science was held on May 31 and June 1, at Conway, N. H. At the Friday evening session, several papers were read by members, and a group of short films was shown as a sample of the science titles in the teaching and loan library of films maintained by the University of New Hampshire.

Saturday morning was entirely devoted to a symposium, "The Bedrock Geology of New Hampshire." The introductory paper on methods and history in this rapidly developing field was by Professor Marland P. Billings, of Harvard. There followed five reports of investigation in special regions: Mt. Cube, by Dr. Jarvis B. Hadley, of Tufts College; Mt. Cardigan, by Dr. Katharine Fowler-Billings; Winnipesaukee, by Dr. Alonzo Quinn, of Brown University; the Dover-Portsmouth area, by Dr. T. R. Meyers, of the University of New Hampshire; and the region of Lewiston, Maine, by Dr. Lloyd W. Fisher, of Bates College.

Saturday afternoon was given over to the reading of other papers by members, to the business meeting, and to the address of the retiring president, Dr. George White, of the University of New Hampshire, on "New Hampshire Mineral Resources."

At the business meeting it was voted to award the grant-in-aid for the current year from the American Association for the Advancement of Science to Professor T. R. Meyers, of the University of New Hampshire, for a continuation of his study on the stratigraphy, structure and petrology of southeastern New Hampshire.

It was voted to elect Professor Marland P. Billings, of Harvard, to honorary membership in the New Hampshire Academy of Science "for his extensive and critical studies of New Hampshire igneous, structural and historical geology, and for his example and guidance, which has given rise to a whole 'Billings school' of researchers in New Hampshire geology."

The publication committee reported ready for distribution the academy's Bulletin No. 1, an illustrated 40-page booklet called "Geology of the Presidential Range," by Richard P. Goldthwait.

The following officers were elected for 1940–41: *President,* Professor Bancroft H. Brown, Dartmouth College; *Vice-President,* Mr. Charles D. Howard, State Board of Health, Concord; *Secretary-Treasurer,* Professor W. W. Ballard, Dartmouth College; *Member of Executive Council,* Professor George White, University of New Hampshire, for five years.

The executive council voted to hold the next annual meeting at Durham, in the fall of 1941.

W. W. BALLARD,
Secretary

THE NEW YORK STATE GEOLOGICAL ASSOCIATION

THE sixteenth annual field meeting of the New York State Geological Association opened at Catskill, New York, on April 25, with a preliminary conference attended by about 100 geologists. The field trips on Friday and Saturday, April 26 and 27, were participated in by nearly 300 persons (over 70 cars and buses), including those who elected the special trips offered on Saturday and Sunday.

The annual dinner on Friday evening, with 225 at table, was followed by the business meeting and by talks and moving or color pictures on the local geology, with Dr. and Mrs. Nelson H. Darton as guests of honor. A letter of congratulations to Dr. Herman L. Fairchild on his approaching ninetieth birthday was voted and was signed by a large number of those present. Rochester was chosen as the meeting place for 1941, with Dr. Harold L. Alling for president and Professor J. Edward Hoffmeister secretary. Dr. Alling showed moving pictures in color of the 1939 meeting. Dr. Darton described his experiences in the early mapping of the region and his recollections of the famous men now dead who had worked here. Yates Wilson and John Cook discussed various phases of the geology east of the Hudson. Harry Eaton spoke on Amos Eaton, whose geological career began in Catskill. A set of colored photomicrographs of the local strata was then shown by Dr. Alling, followed by color pictures of Glacier National Park by Dr. Dyson.

A committee to prepare a plan to encourage teaching of geology in the secondary schools was also voted and will be appointed by the new president. Officers for the Catskill meeting were G. H. Chadwick and Robert Weeks Jones. By courtesy of the school authorities, the new Catskill High School building was used as headquarters.

The committee on nominations consisted of Dr. Robert Wesley Brown, Dr. Nelson C. Dale and Dr. Irving G. Reimann.

GEORGE H. CHADWICK

SPECIAL ARTICLES

ALCOHOLIC FERMENTATION BY FUSARIA JUICE OBTAINED WITH A WET CRUSHING MILL

THE study of certain aspects of the mode of action of cell-free yeast juices from the point of view of colloid chemistry was introduced several years ago,[1,2,3] and led, among other developments, to the experimentally established rule that enzymes in juices and within the cell may change their activity in accordance with the degree of dispersion of the accompanying carriers. Miss M. G. Macfarlane[4] presents an impressive, though presumably far from complete list of differences in behavior between the living yeast cell and the so-called cell-free extracts in regard to the mechanism of alcoholic fermentation. The fermenting cell-free juices generally used (prepared according to Buchner, Lebedew or Lipmann) necessarily exhibit partial or complete suppression of activities or losses of a single or several members of the enzyme systems involved. This accounts for the well-known fact that the harmonious order of the living cell and the phase sequence of enzyme action within it become disorganized due, *e.g.*, to dilution, disruption of carrier systems because of possible denaturation, proteolysis, etc.

A cell system which exhibits, beyond doubt, a measurable phosphorylation and subsequent dephosphorylation of carbohydrates during fermentation is that of the Fusaria. It was deemed justified, therefore, to attempt to investigate an artificial enzyme system from *Fusarium lini Bolley* extracted with the aid of the Booth-Green wet crushing mill.[5] This juice, due to the manner of its preparation, could, if found to be at all active, be compared to a large extent with the juice obtained long ago by Dixon and Atkins,[6] but scarcely investigated by them.

After applying a slight mechanical improvement to the mill, we obtained a juice which can be described as follows. It is opaque; its color varies from light yellow to reddish-brown, according to the distribution of the pigment present.[7] Its pH, prepared with water, is in the neighborhood of 5.7 (the internal cell pH of *Fusarium lini Bolley* lies between 6.0 and 6.1[8]); its relative viscosity measured at 25.3° is 1.168, the determination on the juice having been made a few days after preservation at 6°.

The measurable esterifying capacity of the juice at 28°, as determined by the method of Fiske and Subbarow,[9] amounts under our experimental conditions to about 35 to 40 per cent. of the phosphorylation in the living cell system. In some cases this appears to have been preceded by a dephosphorylation of the organic phosphate donators originally present in the living Fusaria cells.[10] The esterification brought about by the quantity of inorganic phosphate present amounted to about 3 to 4 per cent. The quantity of CO_2 obtained by the action of the zymases compared favorably with that of the living system.

Judging from the data available at present, and taking into consideration the fact that the crushing of the cell makes uniform the highly different pH values of closely organized cell particles,[11] the cell-free Fusaria juice obtained with the wet crushing mill seems to have furnished us so far with an enzyme system which does not exhibit deficiencies or distortions of kind or magnitude as compared with the usual maceration juices obtained from yeasts.

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THE ACTION OF TYPE-SPECIFIC ANTIBODY UPON THE PULMONARY LESION OF EXPERIMENTAL PNEUMOCOCCAL PNEUMONIA[1]

ALTHOUGH the effectiveness of type-specific antiserum in the treatment of pneumococcal pneumonia is well established, the action of antibody upon the pulmonary lesion is not clearly understood. Considerable evidence[2,3,4] has been advanced supporting the view that antibody can not penetrate areas of consolidation within the lung. Recently Kempf and Nungester[5] have studied the penetration of antipneumococcal immune bodies into pneumonic lesions produced experimentally in rats. Using both horse and rabbit antiserum, they were unable to demonstrate the presence of antibody in the lungs following intravenous treatment. They concluded that, even were it found to penetrate the consolidated area, the antibody could not be expected to accumulate in sufficient concentration to neutralize the pneumococcal polysaccharide present in the alveoli.

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2 B. S. Kline and M. C. Winternitz, *Jour. Exp. Med.*, 21: 311, 1915.
3 T. T. Wang and C. M. Van Allen, *Proc. Soc. Exp. Biol. and Med.*, 30: 814, 1933.
4 J. P. Fox, *Jour. Immunol.*, 31: 7, 1936.
5 A. H. Kempf and W. J. Nungester, *Jour. Infect. Dis.*, 65: 1, 1939.

Nye and Harris,[6] studying human autopsy material, have reached the same conclusion.

The purpose of this paper is to report preliminary data which demonstrate that antipneumococcal immune bodies not only enter the pneumonic lesion but do so in sufficient amounts to limit its spread. The antibody is shown to cause agglutination of the pneumococci within the alveoli and to promote rapid phagocytosis of the organisms by the cells of the pneumonic exudate.

Experimental lobar pneumonia was produced in white rats by inoculation of the left main bronchus with encapsulated Type I pneumococci[7] suspended in mucin. The method of Nungester and Jourdonais,[8] modified to increase the severity of the disease, was used in all experiments.[9] The pneumonia produced was uniformly fatal, killing all of 38 untreated rats in less than 5 days. Half of the animals died within 48 hours. In only 4 rats was the lesion confined to the left lung, and all but 1 developed pleurisy, pericarditis, or both. All had bacteriemia at the time of death.

The pathogenesis of the pulmonary lesion was studied by examining the lungs of 35 rats killed at various intervals following inoculation. The pneumonic process was seen to spread rapidly until nearly the entire left lung was involved in 36 hours. Frequent blood cultures showed invasion of the blood stream in roughly half of the animals after 12 hours and in over 90 per cent. at the end of the first day. The lungs of each rat were fixed in Zenker-formol solution according to the method of Loosli,[10] and sagittal sections of the single-lobed left lung were stained by the Gram-Weigert technique. The most striking feature of the spreading lesion was the presence of the edema zone[11,12] at the advancing margin. The pneumococci were seen to be most numerous in this region and histological examination of the lungs at intervals from 12 to 36 hours revealed that the pneumococci spread into normal alveoli principally by way of the edema fluid.

The action of type-specific antibody upon the advancing lesion was observed in rats treated 2, 6, 12 and 18 hours after inoculation. One cc (6,000 units) of concentrated antipneumococcal rabbit serum[13] was injected into the femoral vein of each animal in a single dose.[14] The rats were killed in groups of 3 at 1, 6, 18, 42, 96 and 168 hours after treatment; the lungs were fixed and stained by the methods already described. No deaths due to pneumonia occurred among the 76 treated animals, in spite of the fact that many had already developed bacteriemia at the time of treatment. The bacteriemia cleared following therapy and autopsy findings indicated that the pulmonary lesion had been promptly arrested by the serum. The margin of the consolidated area was seen in the gross to become sharply demarcated 6 to 18 hours after treatment, in striking contrast to the irregular hemorrhagic border characteristic of an advancing lesion. Microscopic examination showed pronounced agglutination of the pneumococci, particularly in the edema zone, within an hour. Organisms with swollen capsules were noted frequently. Following agglutination of the pneumococci, the pneumonia failed to spread as evidenced by narrowing of the edema zone at 6 hours and its disappearance after 18 to 42 hours. The agglutination of the organisms in the edema zone appeared to prevent them from invading new alveoli and thus apparently allowed leucocytes to overtake them at the margin of the lesion. Marked phagocytosis of pneumococci by the polymorphonuclear leucocytes was noted at 6 hours and few, if any, organisms could be found, either extracellularly or intracellularly, after 96 hours. The macrophage reaction[15] became prominent in 4 days, and at the end of one week there was extensive clearing of the exudate.

Conclusions

Type-specific immune bodies contained in antipneumococcal rabbit serum, when administered intravenously in sufficient quantity, enter the pneumonic lesions of rats with experimental pneumococcal pneumonia. The antibody agglutinates the pneumococci free in the alveoli and thus apparently stops the spread of the pneumonic process. Clumped cocci can be seen throughout the involved area, but particularly in the edema zone at the advancing margin of the lesion. The presence of antibody within the alveoli is likewise revealed by the "Quellung" phenomenon and by a marked increase in the phagocytosis of organisms by the cells of the alveolar exudate.

The author is indebted to Dr. J. F. Enders for much helpful advice, and to Mr. John Burke for the preparation of microscopic sections.

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[6] R. N. Nye and A. H. Harris, 2nd, *Am. Jour. Path.*, 13: 749, 1937.

[7] A5 strain, kindly supplied by Dr. O. H. Robertson.

[8] W. J. Nungester and L. F. Jourdonais, *Jour. Infect. Dis.*, 59: 258, 1936.

[9] Details of the method will be described in a later publication.

[10] C. G. Loosli, *Arch. Path.*, 24: 743, 1937.

[11] O. H. Robertson, L. T. Coggeshall and E. E. Terrell, *Jour. Clin. Invest.*, 12: 467, 1933.

[12] F. D. Gunn and W. J. Nungester, *Arch. Path.*, 21: 813, 1936.

[13] Obtained through the courtesy of Dr. W. G. Malcolm of the Lederle Laboratories.

[14] Subsequently, smaller amounts of antibody were used with similar results. As little as 120 units was found to be effective in rats treated 12 hours after inoculation.

[15] O. H. Robertson and C. G. Loosli, *Jour. Exp. Med.*, 67: 575, 1938.

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GROWTH RESPONSE OF PLANTS TO RIBOFLAVIN AND ASCORBIC ACID

EXPERIMENTS at the University of Iowa on mineral nutrition of plants, involving the addition of riboflavin and ascorbic acid, have disclosed certain marked responses to these vitamins. Data are given for replicate pot cultures of eggplant (*Solanum melongea,* variety Black Beauty) and tobacco (*Nicotiana tobaccum,* variety Little Turkish) grown in silica gravel with Withrow's nutrient solution. Controls received only mineral salts while test cultures of the eggplant were supplemented with 2.5 P.P.M. synthetic (Merck) riboflavin, and those of tobacco were supplemented with 10 P.P.M. synthetic (Merck) ascorbic acid, dissolved directly in the aqueous solution. Pots were drained on alternate days and fresh nutrient solution added to maintain a uniform supply of mineral salts and vitamins.

Data (Table I A) show that riboflavin increased the growth of eggplant and (Table I B) that ascorbic acid increased the growth of tobacco.

TABLE I

A. GROWTH RESPONSE OF EGGPLANT IN NUTRIENT SOLUTION CONTAINING RIBOFLAVIN

Age of plants in days	Stem length, cm.		Fresh weight of tops in gms.		Per cent. dry weight		Fresh weight of roots in gms.		Per cent. dry weight	
	Control	Test	Control	Test	Control	Test	Control	Test	Control	Test
56	6.2	12.1	13.5	45.5	17.5	12.3	1.6	3.0	14.0	20.2
77	7.1	14.2	48.5	121.0	12.7	12.3	12.5	22.9	9.9	9.4

B. GROWTH RESPONSE OF TOBACCO IN NUTRIENT SOLUTION CONTAINING ASCORBIC ACID

56	25.1	34.2	38.2	82.8	8.2	8.1	3.0	5.9	12.1	16.3

The initial gain of eggplants receiving riboflavin was maintained throughout growth. The leaves were consistently coarser in texture, thicker, and darker in color than the controls. The roots were coarser and more extensive. Shoots of 56-day-old riboflavin plants were more highly hydrated (dry weight 12.3 per cent.) than controls (dry weight 17.5 per cent.), but the converse relationship existed in the roots (dry weight of riboflavin plants 20.2 per cent., controls 14.0 per cent.). These differences in percentage of dry weight tended to level out in both tops and roots with increasing age. At the age of 77 days the dry weight of tops of both test and control plants was approximately 12.5 per cent. and of both sets of roots about 9.5 per cent.

In most respects the tobacco plants receiving ascorbic acid showed gains in growth comparable to those of the eggplants receiving riboflavin. Hydrogen ion determinations of the press sap showed that riboflavin increased the acidity of the apices of the eggplant, while with the ascorbic acid there was a slight decrease in the acidity of the stem tips of the tobacco plants. The plants receiving the vitamins showed smaller pH variations of the different regions than in the controls. Initial gains due to the two vitamins were maintained throughout the experiment. Compositional differences persisted in mature plants even where gross external contrasts tended to disappear.

The data suggest definite species differences in response to riboflavin and ascorbic acid, as well as the marked stimulatory effect of riboflavin which has not been previously reported. The experiments are being continued to determine the exact character of the histological and metabolic differences in various species under the influence of riboflavin and ascorbic acid.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF PLASTIC AS A SUBSTITUTE FOR COVER GLASSES

As a result of the present conflict in Europe, the price of cover glasses used in the preparation of slides for the microscopic study of tissues has risen so much that the question as to how to meet this increase in price has become a serious problem for those laboratories in which the number of tissues studied in serial sections is great. There seems, accordingly, to be a widely felt need for a less expensive substitute for imported cover glasses. We have found that plastic serves for this purpose.

The use of plastic as a substitute for cover glasses in microscopic technique is not new, since Lentze[1] had recommended similar material about ten years ago. However, some difficulties are encountered in the covering of microscopic sections with plastic, which seem so far to have prevented the wider use of this material; but it is possible to overcome these difficulties to a very large extent and we wish therefore to describe the method which we have found to be satisfactory.

We are using cellulose acetate, trade name "Vue Pak,"[2] which can be obtained in sheets 0.005 inch or 0.127 mm thick, corresponding approximately to the thickness of cover glasses No. 1, which varies between 0.13 mm and 0.14 mm. The refractive index of this material is 1.49 to 1.50, which is very nearly that of glass. Resistance to heat is 140–180° F. Exposure of the mounted and dried slides first to a temperature of 110–115° F. for twelve hours, then keeping them at room temperature for another twelve hours, with a

[1] H. Lentze, *Klin. Wochenschr.*, 9: 1470, 1930.

[2] "Vue Pak" prepared by Monsanto Chemical Company.

repetition of this procedure on several days, left them unchanged. The effects of sunlight, weak acids and weak alkalies are very slight.

The plastic is obtained in sheets which can be cut in such a way that their size and shape are the same as those of cover glasses. These slips are kept covered on both sides with sheets of tissue paper. They are, as a rule, clean, but if cleaning should be necessary, they may be dipped in 50 per cent. alcohol, one at a time, and dried immediately. Thick, paper-filtered Canada balsam serves as mounting medium. The use of an excessive amount of xylol should be avoided.

The most objectionable feature in the use of plastic in the place of cover glasses is their tendency to "curl" during the process of drying. If the slips are kept in the oven overnight at a temperature of 37° C., from three to five per cent., sometimes even a larger number, of the cover slips may pull away at the edges. To overcome this difficulty as much as possible it is necessary, after mounting, to dry the slides slowly at room temperature for five to six days, in order that the Canada balsam may be well hardened before placing the slides into slide boxes. In this way as a rule a fairly satisfactory result is obtained, although the smoothness of the plastic is not always equal to that of cover glasses.

After the appearance of the article by H. O'Brien,[3] we substituted isobutyl methacrylate polymer for Canada balsam. The solution found suitable was approximately 1 part of isobutyl methacrylate polymer[4] to 2½ parts of xylol. These experiments are still in an early stage, but it seems that this change improves the results. Under these conditions the drying requires not more than one day and, so far, no curling of the plastic cover slips has occurred.

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ERRATIC POTENTIALS OF ELECTRODES SEALED IN GLASS TUBING

OUR attention has been drawn to the erratic potentials that are observed in the potentiometric titration of dilute solutions in which platinum electrodes, sealed in glass tubing, are used. These erratic potentials were particularly obnoxious near the end point of a titration. We have noted them specifically in the potassium dichromate-stannous chloride and the thallous chloride-potassium iodate titrations. Complete elimination of this erratic behavior was obtained by removing the glass tubing from the electrode, or, by allowing only the wire (electrode) to touch the solution being titrated or the electrolyte of the cell being studied.

[3] Harold C. O'Brien, SCIENCE, 91: 412, 1940.

[4] The isobutyl methacrylate polymer prepared by du Pont Company.

A general investigation has indicated that the erratic behavior of electrodes sealed in glass tubing is much more prevalent than one would normally be led to believe is true. Apparently most observers have attributed the erratic potentials to some peculiarity of the reaction involved rather than to the physical structure of the electrode assembly. Particularly does this seem to be a source of trouble in the erratic behavior of certain E.M.F. cells built for special purposes. This phenomenon may be crucial in these cases, for not only are fluctuation or drifts introduced but the induced potentials may be large (300 mv) and irreproducible.

The cause of this trouble has not been entirely established. It may be due, partially or entirely, to strains in the electrodes as a result of the glass-metal seal. This may result in a variable junction potential as a result of the solution being in contact with the same metal in different standard states; this could be reduced to a constant value or eliminated by a very careful annealing process. The disturbance is definitely in the region of the glass-metal-solution interface. Elimination of this interface seems to eliminate the source of trouble. In potentiometric titrations, where the electrodes must be subject to frequent cleaning by burnishing in a flame or treatment with hot aqua regia, we have found it highly desirable to eliminate the glass casing for the electrodes or to construct the electrode in such a manner that the solution does not come into contact with the metal-glass interface. This may also be necessary for many other types of cell measurements. Our recent experiences with this phenomenon have been such that we are certain that it is of a general nature and requires consideration where cell data are being obtained.

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